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Development of Trawls for Medium Sized Trawlers for Veraval, North-West Coast of India

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Comparative fishing experiments with 25 m bulged belly and 25 m six seam trawls were carried out to study the relative efficiency of the gear. Bulged belly trawl was found more efficient than the other at depths below 40 m. The tension and horizontal opening were more in bulged belly and six seam trawl respectively. Bulged belly caught more of prawns and lobsters but there was no significant difference in the catch of sciaenids, cephalopods and ribbon fishes in the two nets.

Varghese *et al.* (1968) reported bulged belly trawls as more suitable for prawns and fishes off Cochin. Pillai *et al.* (1978) observed bulged belly trawl quite appropriate for bottom and column fishes in depths 20-40 m off Cochin. Deshpande *et al.* (1970) studied the suitability of six seam trawl off Veraval. However, systematic attempts were not made to study the operational characteristics and relative efficiency of the above two nets. Experiments carried out by the authors with the two types of nets are presented in this communication.

Materials and Methods

A bulged belly trawl with 25 m head rope and a six seam trawl of 25 m head rope as described by Deshpande *et al.*, (1970) were operated together with flat rectangular otter boards of 1524 mm × 762 mm size weighing 100 kg each in air (Kuriyan *et al.*, 1964). Fishing conducted in 1977 from the institute vessel Fishtech 8, 15.2 m OAL and fitted with 165 HP engine. The depth of the fishing ground varied from 26 to 55 m off Veraval.

The details of the two nets are shown in Figures 1 & 2 and Tables 1a, 1b, 1c, 2a, 2b, 2c and 3. Both the nets were operated the same day keeping depth, ground, length of warp, trawling speed, duration of each haul and course constant. Each net was provided with a double sweep line of 5 m long in between the net leg and otter board.

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Towing warp tension and horizontal opening between otter boards were recorded as described by Benyami (1959), Deshpande (1960) and Satyanarayana & Nair (1965). The catch and composition of each haul were recorded separately for the two gears. 74 hauls, each of one hour duration with both nets were made. The nets landed a total of 13,658.650 kg fish.

Results and Discussion

The results of comparative hauls made at two depth zones, namely upto 40 m (26-39 m) and beyond 40 m (40-55 m) are presented in Table 4 and composition of catch in Table 5. Analysis of variance of data for 26-39 m and 40-55 m are given in Tables 6 and 7. For analysis, data on catch and tension were converted to their log values. Analysis were done separately for 26-39 m and 40-55 m. From Table 4 and 5 it is clear that the bulged belly is more efficient than the six seam trawl with respect to catch. In shallow waters (upto 40 m) the total catch of the two nets showed (Table 6c) a significant difference ($p < 0.05$). Quality fishes, sciaenids, cephalopods and ribbon fishes landed by the two nets were not significant at 5% level. But there was a significant difference ($p < 0.01$) in the landing of miscellaneous fishes, prawns and lobsters in the two nets. Bulged belly trawl landed more from the two depth zones compared to six seam trawl (Tables 6 g and 6 h). Same trend was observed in deeper waters (beyond 40 m). Significant difference ($p < 0.01$) in the prawn and lobster catches of

the two nets was observed (Table 7 g). The difference in the total catch of the two nets was significant at 5% level only (Table 7c) in deeper waters. However this may be confirmed by further studies. The increase in the catch of six seam net in deeper waters (Table 4 and 5) was due to the increased landings of ribbon fishes at random where as all the other fishes were caught at par with that of bulged belly trawl. It may be concluded that the bulged belly trawl may be more efficient in catching the 'shallow water mix' consisting mainly of small miscellaneous fishes and crustaceans which are more abundant there than in deeper waters. Similar observations were also made by Pillai *et al.* (1978) in shallow waters (20-40m) off Cochin.

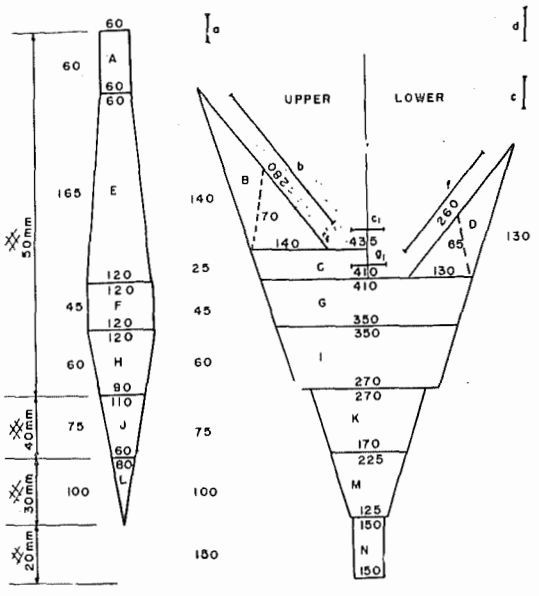

Fig. 1. 25 m bulged belly trawl

The percentage horizontal opening of the two nets differ significantly ($p < 0.01$). Six seam trawl had higher percentage opening compared to bulged belly trawl at all depths (Tables 4, 6b, and 7b). Reduced horizontal spread of bulged belly trawl may be due to increased bottom friction. Factors like smaller mesh size, many meshes and larger quantity of twine in bulged belly trawl (Table 3) would have offered more resistance which in turn might have reduced the horizontal spread. This was evident in shallow waters where bottom friction was more. However, there was no corresponding increase of catch in relation to the increased horizontal opening

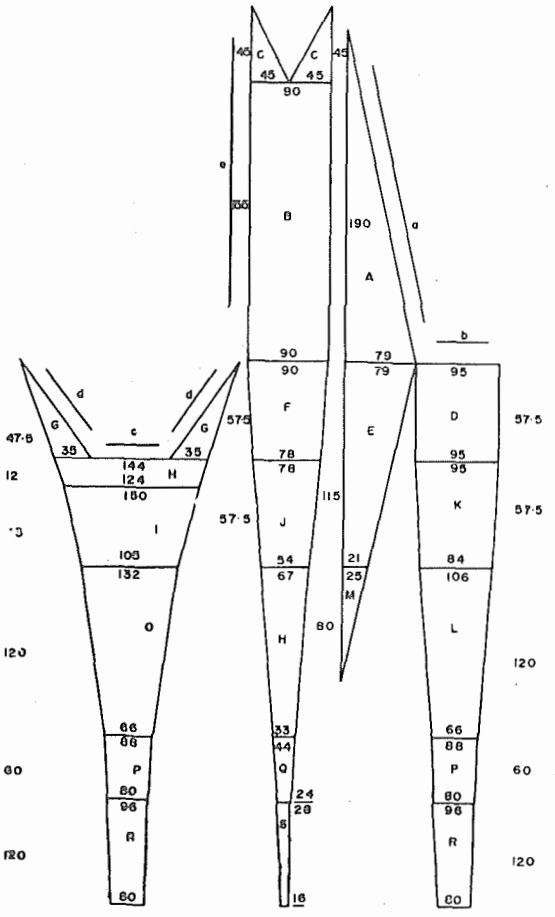

Fig. 2. 25 m six seam trawl

of six seam trawl in shallow waters. It may be noted that the increased horizontal opening obtained by six seam trawl had no added advantage over the bulged belly trawl in shallow waters.

The trawl warp tension offered by the two nets was significantly different ($p < 0.01$). The bulged belly trawl had more tension compared to six seam trawl (Table 4, 6a, and 7a) at all depths. This is in accordance with the above findings that bulged belly trawl was offering more resistance indicated by the increased warp tension. Factors offering more resistance might have produced increased warp tension as the other parameters were kept constant. In all the cases between days variations were highly significant ($p < 0.01$).

As the catching efficiency of bulged belly trawl was found to be more in shallow waters it can be recommended for the exploitation

Table 1a. *Details of 25 m six seam bulged belly trawl*

Webbing	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Twine diameter mm							15												
Breaking strength kg							36												
Stretched mesh mm	63	63	63	63	63	63	76	76	63	63	63	50	50	50	50	38	38	31	31
Upper edge meshes	1	90	1	95	79	90	1	144	150	70	95	106	25	67	132	88	44	96	28
Lower edge meshes	79	90	45	95	21	78	35	124	105	54	84	66	1	33	66	80	24	80	16
Depth meshes	190	155	45	57.5	115	57.5	47.5	12	43	57.5	57.5	120	80	120	120	60	60	120	120
Baiting rate Inner	...	...	...	...	...	...	1:4	...	...	...	...	...	...	...	...	...	...	...	...
Outer	1:2.4	...	1:1	...	1:2	1:4.8	1:1	1:1.2	1:1.9	1:2.4	1:5	1:6	1:3.3	1:7	1:3.6	1:15	1:6	1:15	1:20
Co-efficient of hanging	0.87	0.87	0.87	0.50	...	...	0.97	0.50											
Hanging	$\frac{a}{A+C}=\frac{11.0}{12.6}$	$\frac{c}{BC}=\frac{11.0}{12.6}$	...	$\frac{b}{D}=\frac{3.0}{6.0}$	...	...	$\frac{d}{G}=\frac{3.5}{3.6}$	$\frac{c}{H}=\frac{2.8}{5.6}$											

* Blue high density polyethylene with single trawl knot

Total weight of the net 45 kg

of 'shallow water mix'. Both the nets were found equally effective for the capture of all other varieties of fishes. Six seam trawl was cheaper (32.4%) and with lesser warp tension (7.6% in shallow and 4% in deeper waters) than bulged belly trawl. This indicates the possibility of either six seam trawl to be increased in size or it be towed at a faster speed with the given engine power.

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Table 1b. *Details of lines and ropes**

	a	b	c	d	e
Material		High density polyethylene			
Diameter mm	18	18	18	18	18
Breaking strength kg	3460	3460	3460	3460	3460
Length m	11.0	3.0	2.8	3.5	11.0
* Head rope: 25 m			*Foot rope: 31.8m		

Table 1c. *Details of floats, sinkers and otter boards*

	Floats	Sinkers	Otter boards
Number	11	—	2
Material	Hard plastic	Iron	Iron and wood
Shape	Spherical	Link chain	Rectangular flat
Diameter mm	150	6	—
Length mm	—	—	1524
Breadth mm	—	—	762
Static buoyancy kg	1.550 each	—	—
Weight in air kg	0.300 each	30.0	100.0 each

Table 2a. *Details of 25 m bulged belly trawl**

Webbing	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Twine diameter mm							1.5							2
Breaking strength kg							36							45
Stretched mesh mm	50	50	50	50	50	50	50	50	50	40	40	30	30	20
Upper edge meshes	60	1	435	1	60	120	410	120	350	110	270	80	225	150
Lower edge meshes	60	140	410	130	120	120	350	90	270	60	170	1	125	150
Depth meshes	60	140/280	25	130/260	165	45	45	60	60	75	75	100	100	150
Baiting rate	...	1:2	1:2	1:2	1:5.5	...	1:1.5	1:4	1:1.5	1:3	1:1.5	1:2.5	1:2	—
Cutting rate	...	1p2b	1p2b	1p2b	4p2b 5p2b	...	1p4b	3p2b	1p4b	1p1b	1p4b	3p4b	1p4b	—
Co-efficient of hanging	0.75	0.60	0.45	0.75	0.90	0.58	0.47							
Hanging	$\frac{a}{A}=\frac{2.25}{3.00}$	$\frac{b}{B}=\frac{8.50}{14.00}$	$\frac{c}{C}=\frac{3.50}{7.75}$	$\frac{d}{A}=\frac{2.25}{3.00}$	$\frac{e}{E}=\frac{1.50}{1.65}$	$\frac{f}{D}=\frac{7.5}{13.00}$	$\frac{g}{G}=\frac{3.50}{7.50}$							

*Blue high density polyethylene with single trawl knot Total weight of the net 57 kg

Table 2b. *Details of lines and ropes**

	a	b	c	d	e	f	g	leg	leg
Material	High density polyethylene								
Diameter mm	18	18	18	18	18	18	18	18	18
Breaking strength kg	3460	3460	3460	3460	3460	3460	3460	3460	3460
Length m	2.25	8.50	3.50	2.25	1.50	7.50	3.50	5.00	5.00

* Head rope: 25 m *Foot rope: 26 m

Table 2c. *Details of floats, sinkers and otter boards*

	Floats	Sinkers	Otter boards
Number	11	—	1 pair
Material	Plastic (hard)	Iron	Iron and wood
Shape	Spherical	Link chain	Rectangular flat
Diameter mm	150	6	—
Length × breadth mm	—	—	1524 × 762
Static buoyancy kg	1.550 each	—	—
Weight in air kg	0.300 each	30.00	100 each

Table 3. *Comparative details of the two nets*

Particulars	25 m bulged belly trawl	25 m six seam trawl
Total number of meshes	3,33,000	1,72,000
Range of mesh size mm	20–50	30–75
Quantity of twine kg	40	25
Quantity of ropes and lines kg	17	20
Cost of materials Rs	1,425	1,125
Fabrication charges Rs	1,200	650
Total cost Rs	2,625	1,775

Table 4. *Results of comparative fishing with 25m bulged belly trawl and 25m six seam trawl*

Particulars	26-39 m depth		40-55 m depth	
	25m bulged belly trawl	25m six seam trawl	25m bulged belly trawl	25m six seam trawl
Number of hauls	57	57	17	17
Duration h	57	57	17	17
Trawl warp tension kg				
Average	522.6	482.9	542.0	521.0
Range	448–658	403–605	425–684	425–630
Horizontal opening at otter boards m				
Average	18.83 (41.34%)	22.80 (50.78%)	25.87 (57.50%)	29.68 (66%)
Range	15.52–24.73 (34.54–54.95%)	17.78–28.67 (39.63–63.72%)	23.50–28.50 (52.22–63.33%)	28.12–30.98 (62.48–68.80%)
Total catch kg	5679.55	4591.35	1362.45	2025.30
Catch per unit effort kg/h	99.64	80.55	80.14	119.13
Range	11.25–716	1.60–475	15.10–196	9.20–339.5

Table 5. *Composition of catch in 25m bulged belly trawl and 25m six seam trawl*

	26–39m depth				40–55m depth			
	25m bulged belly trawl		25m six seam trawl		25m bulged belly trawl		25m six seam trawl	
	kg	%	kg	%	kg	%	kg	%
Quality fishes	76.95	37.3	129.40	62.7	112.50	60.3	73.95	39.7
Ribbon fish	1185.05	54.0	1013.45	46.0	195.50	19.5	808.00	80.5
Sciaenids	450.00	52.5	405.00	47.5	7.00	23.3	23.00	76.7
Lactarius	717.00	70.2	303.00	29.8	24.00	40.0	36.00	60.0
Elasmobranchs	3.35	7.0	45.30	93.0	17.50	43.5	22.80	56.5
Cephalopods	150.00	55.0	123.00	45.0	103.50	50.8	100.00	49.2
Prawns and lobsters	70.20	63.0	41.00	37.0	10.45	61.4	6.55	38.6
Miscellaneous fishes	3027.00	54.4	2531.20	45.6	902.00	48.6	955.00	51.4
Total	5679.55	55.2	4591.35	44.8	1372.45	40.5	2025.30	59.5

Table 6a. *Anova of tension (26-39m)*

Source	ss	df	ms	f
Total	0.2334	113		
Nets	0.0300	1	0.0300	33.33**
Days	0.1497	56	0.0026	2.89**
Error	0.0537	56	0.0009	

Mean Tension	Bulged belly trawl	Six seam trawl
Log units	2.7140	2.6815
Actual kg	517.60	480.30

**P<0.01

Table 6b. *Anova of percentage opening (26-39m)*

Source	ss	df	ms	f
Total	6361.3546	113		
Nets	2264.6107	1	2264.6107	931.75**
Days	3961.1332	56	70.7345	29.10**
Error	136.1107	56	2.4305	

Mean % opening	25m bulged belly trawl	41.87
	25m six seam trawl	50.78

**P<0.01

Table 6c. *Anova of total catch*

Source	ss	df	ms	f
Total	19.1088	113		
Nets	0.3639	1	0.3639	5.78*
Days	15.2119	56	0.2716	4.31**
Error	3.5330	56	0.0630	

Mean total catch	25m bulged belly trawl	25m six seam trawl
Log units	1.8344	1.7214
Actual kg	68.29	52.65

*P<0.05
**P<0.01

Table 6d. *Anova of quality fishes (26-39m)*

Source	ss	df	ms	f
Total	15.0804	113		
Nets	0.2207	1	0.2207	3.22
Days	11.0235	56	0.1968	2.87**
Error	3.8362	56	0.0685	

**P<0.01

Table 6e. *Anova of sciaenids (26-39m)*

Source	ss	df	ms	f
Total	33.6113	113		
Nets	0.0091	1	0.0091	0.24
Days	31.4677	56	0.5619	14.75**
Error	2.1345	56	0.0381	

**P<0.01

Table 6f. *Anova of cephalopods (26-39m)*

Source	ss	df	ms	f
Total	15.2840	113		
Nets	0.0806	1	0.0806	1.97
Days	12.9107	56	0.2305	5.64**
Error	2.2927	56	0.0409	

**P<0.01

Table 6g. *Anova of prawns and lobsters (26-39m)*

Source	ss	df	ms	f
Total	6.3242	113		
Nets	0.1679	1	0.1679	10.43**
Days	5.2497	56	0.0937	5.82**
Eroor	0.9066	56	0.0161	

Mean catch	Bulged belly trawl	Six seam trawl
Log units	0.2620	0.1852
Actual kg	1.828	1.531

**P<0.01

Table 6h. *Anova of miscellaneous fishes (26-39m)*

Source	ss	df	ms	f
Total	23.6974	113		
Nets	4.7832	1	4.7832	48.66**
Days	13.4077	56	0.2394	2.44**
Error	5.5065	56	0.0983	

Mean catch	Bulged belly trawl	Six seam trawl
Log units	1.8376	1.4279
Actual kg	68.80	26.79

**P<0.01

Table 6i. *Anova of ribbon fishes (26-39m)*

Source	ss	df	ms	f
Total	47.3075	113		
Nets	0.2467	1	0.2467	1.80
Days	39.3923	56	0.7034	5.14**
Error	7.6685	56	0.1369	

**P< 0.01

Table 7a. *Anova of tension (40-55m)*

Source	ss	df	ms	f
Total	0.0744	33		
Nets	0.0026	1	0.0026	26.00**
Days	0.0704	16	0.0044	44.00*
Error	0.0014	16	0.0001	

Mean tension	Bulged belly trawl	Six seam trawl
Log units	2.7316	2.7141
Actual kg	539.1	517.7

**P<0.01

Table 7b. *Anova of percentage opening (40-55m)*

Source	ss	df	ms	f
Total	914.3359	33		
Nets	607.0903	1	607.0903	338.80**
Days	278.5733	16	17.4108	9.72**
Error	28.6713	16	1.7919	

Mean % opening	Bulged belly trawl	Six seam trawl
	57.50	65.96

**P<0.01

Table 7c. *Anova of total catch (40-55m)*

Source	ss	df	ms	f
Total	5.1061	33		
Nets	0.0280	1	0.0280	0.55
Days	4.2662	16	0.2666	5.26**
Error	0.8119	16	0.0507	

**P<0.01

Table 7d. *Anova of ribbon fishes (40-55m)*

Source	ss	df	ms	f
Total	11.7605	33		
Nets	0.1798	1	0.1798	1.05
Days	8.8404	16	0.5525	3.23*
Error	2.7403	16	0.1712	

*P<0.05

Table 7e. *Anova of quality fishes (40-55m)*

Source	ss	df	ms	f
Total	9.0344	33		
Nets	0.1654	1	0.1654	0.09
Days	6.4391	16	0.4024	2.65*
Error	2.4299	16	0.1518	

*P<0.05

Table 7f. *Anova of cephalopods (40-55m)*

Source	ss	df	ms	f
Total	5.3409	33		
Nets	0.0470	1	0.0470	1.03
Days	4.5642	16	0.2852	6.25**
Error	0.7297	16	0.0456	

**P<0.01

Table 7g. *Anova of prawns and lobsters (40-55m)*

Source	ss	df	ms	f
Total	0.9837	33		
Nets	0.0284	1	0.0284	24.70**
Days	0.7710	16	0.0481	4.18**
Error	0.1843	16	0.0115	

Mean catch	Bulged belly trawl	Six seam trawl
Log units	0.1629	0.1051
Actual kg	1. 455	1. 274

**P<0.01

Table 7h. *Anova of miscellaneous fishes (40-55m)*

Source	ss	df	ms	f
Total	10.1297	33		
Nets	0.0365	1	0.0365	0.27
Days	7.9392	16	0.4962	3.69**
Error	2.1540	16	0.1346	

**$P < 0.01$

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